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EXAMINER	
THANGAVELU, KANDASAMY	
ART UNIT	**PAPER NUMBER**
2123	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/814,299	WESSOL ET AL.	
	Examiner	Art Unit	
	Kandasamy Thangavelu	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 October 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-43* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *13,14,16,36,37 and 39-42* is/are allowed.

6)☒ Claim(s) *1-4,8-10,30-32 and 35* is/are rejected.

7)☒ Claim(s) *5-7,10,11,15,17-29,33,34,38 and 43* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 March 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *22 October 2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This communication is in response to the Applicants' Amendments dated October 22, 2004. Claims 1-43 were amended. Claims 1-43 of the application are pending in the application. This office action is made non-final.

Terminal Disclaimer proper

2. The terminal disclaimer filed on 22 October 2004 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 6,175,761 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Information Disclosure Statement

3. Acknowledgment is made of the information disclosure statements filed on October 22, 2004 together with copies of the papers. The patents and papers have been considered.

Claim Objections

4. The following is a quotation of 37 C.F.R § 1.75 (d)(1):

> The claim or claims must conform to the invention as set forth in the remainder of the specification and terms and phrases in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description.

5. Claims 15, 17, 20-30, 32, 38 and 43 are objected to because of the following informalities:

Claim 15, Lines 1-2, "wherein the defining the material to be associated with each the uniform volume element" appears to be incorrect and it appears it should be "wherein the defining the material to be associated with each uniform volume element".

Claim 17, Line 8, "defining a material to be associated with each the uniform volume element" appears to be incorrect and it appears it should be "defining a material to be associated with each uniform volume element".

Claim 20, Lines 1-4, "A computer readable medium having computer executable instructions which when executed on a computer perform a process for tracking a movement of a particle through a geometric model, the process comprising:" appears to be incorrect and it appears it should be "A computer readable medium having computer executable instructions which when executed on a computer perform a process for tracking a movement of a particle through a geometric model, the computer executable instructions comprising instructions for:".

Claim 21, Lines 1-2, "A computer readable medium according to claim 20, further comprising storing" appears to be incorrect and it appears it should be "A computer readable medium according to claim 20, further comprising computer executable instructions for storing".

Claim 22, Lines 1-2, "A computer readable medium according to claim 20, further comprising establishing" appears to be incorrect and it appears it should be "A computer readable medium according to claim 20, further comprising computer executable instructions for establishing".

Claim 23, Lines 1-2, "A computer readable medium according to claim 20, further comprising storing" appears to be incorrect and it appears it should be "A computer readable medium according to claim 20, further comprising computer executable instructions for storing".

Claim 24, Lines 1-2, "A computer readable medium according to claim 23, further comprising computing" appears to be incorrect and it appears it should be "A computer readable medium according to claim 23, further comprising computer executable instructions for computing".

Claim 25, Lines 1-3, "A computer readable medium according to claim 20, further comprising: reading" appears to be incorrect and it appears it should be "A computer readable medium according to claim 20, further comprising computer executable instructions for: reading".

Claim 26, Lines 1-2, "A computer readable medium according to claim 25, further comprising proportionally converting" appears to be incorrect and it appears it should be "A computer readable medium according to claim 25, further comprising computer executable instructions for proportionally converting".

Claim 27, Lines 1-4, "A computer readable medium according to claim 25, wherein the medical image comprises a plurality of substantially cross-sectional slices

of the treatment volume, further comprising stacking" appears to be incorrect and it appears it should be "A computer readable medium according to claim 25, wherein the medical image comprises a plurality of substantially cross-sectional slices of the treatment volume, further comprising computer executable instructions for stacking".

Claim 28, Lines 1-2, "A computer readable medium according to claim 20, further comprising displaying" appears to be incorrect and it appears it should be "A computer readable medium according to claim 20, further comprising computer executable instructions for displaying".

Claim 29, Lines 1-5, "A computer readable medium having computer executable instructions which when executed on a computer perform a process for computationally enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy having a radiation source, the process comprising:" appears to be incorrect and it appears it should be "A computer readable medium having computer executable instructions which when executed on a computer perform a process for computationally enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy having a radiation source, the computer executable instructions comprising instructions for:".

Claim 30, Line 9, "a storage module for storing a material for each the uniform volume elements" appears to be incorrect and it appears it should be "a storage module for storing a material for each of the uniform volume elements".

Claim 32, Lines 2-3, "further comprising defining a material to be associated with each the uniform volume element" appears to be incorrect and it appears it should be

"further comprising defining a material to be associated with each uniform volume element".

Claim 38, Lines 1-3, "wherein the defining the material to be associated with each the uniform volume element further comprises mapping each the material to an array" appears to be incorrect and it appears it should be "wherein the defining the material to be associated with each uniform volume element further comprises mapping each material to an array".

Claim 43, Lines 1-5, "A computer readable medium having computer executable instructions which when executed on a computer perform a process for computationally enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy having a radiation source, the process comprising:" appears to be incorrect and it appears it should be "A computer readable medium having computer executable instructions which when executed on a computer perform a process for computationally enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy having a radiation source, the computer executable instructions comprising instructions for:".

Claim 43, Line 11, "mapping a material associated with each the uniform volume element to an array" appears to be incorrect and it appears it should be "mapping a material associated with each uniform volume element to an array".

Appropriate corrections are required.

Claim R j ctions - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 1, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733).

8.1 **Silver** teaches analytical imaging system and process. Specifically, as per claim 1, **Silver** teaches a method for tracking a particle through a geometric model (CL12, L38-48; CL13, L3-17); the method comprising:

describing a movement of the particle through the geometric model with a particle track (CL13, L3-17).

Silver does not expressly teach arranging a plurality of substantially uniform volume elements into the geometric model. **Kaufman et al.** teaches arranging a plurality of substantially uniform volume elements into the geometric model (Fig. 5A and 5B; Fig 8; CL2, L41-48; CL9, L15-22), because that provides an efficient method of voxelizing 3-D continuous representations of objects and lines and rays (CL3, L51-54); and reduces the inefficiencies associated with ray tracing techniques (CL2, L19-20); by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection (CL1, L43-46). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Kaufman et al.** that included arranging a plurality of substantially uniform volume elements into the geometric model. The artisan would have been motivated because that would provide an efficient method of voxelizing 3-D continuous representations of objects and lines and rays; and would reduce the inefficiencies associated with ray tracing techniques by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection.

Silver does not expressly teach traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer based increments. **Kaufman et al.** teaches traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer based increments (Fig. 5A and 5B; Fig 9; CL9, L15-22), because that provides a ray tracing method that is computationally faster than prior art methods (CL3, L56-59). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of

Kaufman et al. that included traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer based increments. The artisan would have been motivated because that would provide a ray tracing method that would be computationally faster than prior art methods.

Per claim 9: **Silver** teaches the step of setting an initial condition for the particle track (CL13, L3-6).

8.2 As per claim 10, **Silver** and **Kaufman et al.** teach the method of claim 9. **Silver** does not expressly teach that the particle traverses along the particle track beginning in a starting element. **Kaufman et al.** teaches that the particle traverses along the particle track beginning in a starting element of the uniform volume elements and traverses to a next element of the uniform volume elements (Fig 5A; Fig 5B; CL3, L5-24; CL9, L15-19; CL 22, L45-49), because that provides a ray tracing method that is computationally faster than prior art methods (CL3, L56-59). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Kaufman et al.** that included the particle traversing along the particle track beginning in a starting element of the uniform volume elements and traversing to a next element of the uniform volume elements. The artisan would have been motivated because that would provide a ray tracing method that would be computationally faster than prior art methods.

Silver does not expressly teach determining a center value of the starting element along a primary direction of movement for the particle track, the center value representing at least a

portion of an adjusted coordinate from which the particle will begin traversal along the particle track. **Kaufman et al.** teaches determining a center value of the starting element along a primary direction of movement for the particle track, the center value representing at least a portion of an adjusted coordinate from which the particle will begin traversal along the particle track (Fig 5A; Fig 5B; CL3, L5-24; CL9, L15-19; CL 22, L45-49), because that provides a ray tracing method that is computationally faster than prior art methods (CL3, L56-59). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Kaufman et al.** that included determining a center value of the starting element along a primary direction of movement for the particle track, the center value representing at least a portion of an adjusted coordinate from which the particle will begin traversal along the particle track. The artisan would have been motivated because that would provide a ray tracing method that would be computationally faster than prior art methods.

9. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Fox et al.** (U.S. Patent 6,083,167).

9.1 As per claim 2, **Silver** and **Kaufman et al.** teach the method of claim 1. **Silver** does not expressly teach converting a plurality of pixels of information contained in a medical image into the uniform volume elements. **Fox et al.** teaches converting a plurality of pixels of information contained in a medical image into a three dimensional image of the treatment volume (CL5, L41-45), because that would allow the treatment planner to overlay the dose upon the treatment

volume and display this information to the medical personnel (CL5, L49-52). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Fox et al.** that included converting a plurality of pixels of information contained in a medical image into a three dimensional image of the treatment volume. The artisan would have been motivated because that would allow the treatment planner to overlay the dose upon the treatment volume and display this information to the medical personnel.

Kaufman et al. teaches the step of converting a three dimensional image of the treatment volume into the uniform volume elements (Fig. 5A and 5B; Fig 8; CL2, L41-48; CL9, L15-22), because that provides an efficient method of voxelizing 3-D continuous representations of objects and lines and rays (CL3, L51-54); and reduces the inefficiencies associated with ray tracing techniques (CL2, L19-20); by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection (CL1, L43-46). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Kaufman et al.** that included the step of converting a three dimensional image of the treatment volume into the uniform volume elements. The artisan would have been motivated because that would provide an efficient method of voxelizing 3-D continuous representations of objects and lines and rays; and would reduce the inefficiencies associated with ray tracing techniques by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection.

10. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Lauer et al.** (U.S. Patent 6,008,813).

10.1 As per claim 3, **Silver** and **Kaufman et al.** teach the method of claim 1. **Silver** does not expressly teach defining a material to be associated with each of the uniform volume elements. **Lauer et al.** teaches defining a material to be associated with each of the uniform volume elements (CL1, L12-26; CL 4, L20-39), because voxel data can contain digital information representing the physical characteristics of the objects or phenomena being studied (CL 1, L15-16); a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery can utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen (CL2, L36-41). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Lauer et al.** that included defining a material to be associated with each of the uniform volume elements. The artisan would have been motivated because voxel data could contain digital information representing the physical characteristics of the objects or phenomena being studied; a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery could utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen.

10.2 As per claim 4, **Silver Kaufman et al.** and **Lauer et al.** teach the method of claim 3. **Silver** does not expressly teach mapping each material associated with each of the uniform volume elements to an array. **Lauer et al.** teaches mapping each material associated with each of the uniform volume elements to an array (CL1, L21-26; CL 4, L39-44), because a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery can utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen (CL2, L36-41). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Lauer et al.** that included mapping each material associated with each of the uniform volume elements to an array. The artisan would have been motivated because a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery could utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen.

11. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Maki et al.** (U.S. Patent 5,678,556).

11.1 As per claim 8, **Silver and Kaufman et al.** teach the method of claim 1. **Silver** does not expressly teach that the particle track has a primary direction of movement, further comprising traversing the particle along the particle track along the primary direction of movement. **Maki et al.** teaches that the particle track has a primary direction of movement, further comprising

traversing the particle along the particle track along the primary direction of movement (CL 9, L35-39; CL9, L53-58), because the particle directions can be used to find a plurality of photon paths traced by a plurality of photons in a model (CL 3, L38-40). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Maki et al.** that included the particle track having a primary direction of movement, further comprising traversing the particle along the particle track along the primary direction of movement. The artisan would have been motivated because the particle directions could be used to find a plurality of photon paths traced by a plurality of photons in a model.

12. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Moscovitch** (U.S. Patent 5,498,876), **Coniglione et al.** (U.S. Patent 6,589,502), **Fox et al.** (U.S. Patent 6,083,167), **Lauer et al.** (U.S. Patent 6,008,813), and **Mackie et al.** (U.S. Patent 6,345,114).

12.1 As per claim 30, **Silver** teaches a computer readable medium having computer executable modules including computer executable instructions, which when executed on a computer perform a process, comprising a projection module for tracking a movement of a particle through the geometric representation (Fig 3; CL9, L40-42; CL9, L57-60; CL12, L38-48; CL13, L3-17).

Silver does not expressly teach a process for enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy. **Moscovitch** teaches a process for enlarging a radiation distribution of a treatment volume irradiated during a radiation therapy (CL3, L59 to CL 4, L4; CL8, L63-67; CL7, L29-39), because that allows mapping the radiation distribution in a three dimensional structure and calculating the absorbed dose and radiation energy (CL8, L65-67; CL8, L46-48). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the process of **Silver** with the process of **Moscovitch** that included instructions for computationally enlarging a radiation distribution for a treatment volume irradiated during radiation therapy; and computing a distribution of radiation doses based upon the particle movement along each the particle track. The artisan would have been motivated because that would allow mapping the radiation distribution in a three dimensional structure and calculating the absorbed dose and radiation energy.

Silver does not expressly teach having a radiation source. **Coniglione et al.** teaches having a radiation source (CL1, L26-27; CL 10, L13-17), because the radiation therapy is implemented by placing a radiation source near or within the tissue to be treated (CL1, L26-27). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Coniglione et al.** that included instructions for having a radiation source substantially internal within a patient. The artisan would have been motivated because the radiation therapy would be implemented by placing a radiation source near or within the tissue to be treated.

Silver does not expressly teach obtaining a medical image of the treatment volume, the medical image containing a plurality of pixels of information. **Fox et al.** teaches obtaining a

medical image of the treatment volume, the medical image containing a plurality of pixels of information (CL5, L41-45), because that would allow the treatment planner to overlay the dose upon the treatment volume and display this information to the medical personnel (CL5, L49-52). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Fox et al.** that included instructions for obtaining a medical image of the treatment volume, the medical image containing a plurality of pixels of information. The artisan would have been motivated because that would allow the treatment planner to overlay the dose upon the treatment volume and display this information to the medical personnel.

Silver does not expressly teach a reader module for converting a plurality of pixels of information contained in a medical image into a corresponding plurality of uniform volume elements. **Kaufman et al.** teaches a reader module for converting a plurality of pixels of information contained in a medical image into a corresponding plurality of uniform volume elements (Fig. 5A and 5B; Fig 8; CL2, L41-48; CL9, L15-22), because that provides an efficient method of voxelizing 3-D continuous representations of objects and lines and rays (CL3, L51-54); and reduces the inefficiencies associated with ray tracing techniques (CL2, L19-20); by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection (CL1, L43-46). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Kaufman et al.** that included instructions for converting a plurality of pixels of information contained in a medical image into a corresponding plurality of uniform volume elements. The artisan would have been motivated because that would provide an efficient method of voxelizing

3-D continuous representations of objects and lines and rays; and would reduce the inefficiencies associated with ray tracing techniques by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection.

Silver does not expressly teach a modeling module for arranging the uniform volume elements into a geometric representation of the treatment volume. **Kaufman et al.** teaches a modeling module for arranging the uniform volume elements into a geometric representation of the treatment volume (Fig. 5A and 5B; Fig 8; CL2, L41-48; CL9, L15-22), because that provides an efficient method of voxelizing 3-D continuous representations of objects and lines and rays (CL3, L51-54); and reduces the inefficiencies associated with ray tracing techniques (CL2, L19-20); by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection (CL1, L43-46). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Kaufman et al.** that included a modeling module for arranging the uniform volume elements into a geometric representation of the treatment volume. The artisan would have been motivated because that would provide an efficient method of voxelizing 3-D continuous representations of objects and lines and rays; and would reduce the inefficiencies associated with ray tracing techniques by reducing the computer time required for ray tracing by decreasing the time required to determine the ray object intersection.

Silver does not expressly teach a storage module for storing a material for each the uniform volume elements. **Lauer et al.** teaches a storage module for storing a material for each the uniform volume elements (CL1, L12-26; CL 4, L20-39), because voxel data can contain digital information representing the physical characteristics of the objects or phenomena being

studied (CL 1, L15-16); a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery can utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen (CL2, L36-41). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Lauer et al.** that included a storage module for storing a material for each the uniform volume elements. The artisan would have been motivated because voxel data could contain digital information representing the physical characteristics of the objects or phenomena being studied; a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery could utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen.

Silver does not expressly teach at least one of the uniform volume elements being stored as corresponding to the radiation source. **Coniglione et al.** teaches at least one of the uniform volume elements being stored as corresponding to the radiation source (CL1, L7-9; CL 4, L39-44), because the radiation therapy is implemented by placing a radiation source near or within the tissue to be treated (CL1, L26-27). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the modules of **Silver** with the modules of **Coniglione et al.** that included at least one of the uniform volume elements being stored as corresponding to the radiation source. The artisan would have been motivated because the radiation therapy would be implemented by placing a radiation source near or within the tissue to be treated.

Silver does not expressly teach a random generation module for calculating a status of the particle as the movement of the particle is tracked through the geometric representation. **Mackie et al.** teaches a random generation module for calculating a status of the particle as the movement of the particle is tracked through the geometric representation (CL9, L31-47), because that allows tracking randomly distributed particles with the probability of interaction with surrounding material (CL9, L34-41). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the computer readable medium of **Silver** with the computer readable medium of **Mackie et al.** that included a random generation module for calculating a status of the particle as the movement of the particle is tracked through the geometric representation. The artisan would have been motivated because that would allow tracking randomly distributed particles with the probability of interaction with surrounding material.

13. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Moscovitch** (U.S. Patent 5,498,876), **Coniglione et al.** (U.S. Patent 6,589,502), and **Maki et al.** (U.S. Patent 5,678,556).

13.1 As per claim 31, **Silver** teaches creating a geometric model of the treatment volume; describing a movement having a primary direction thereof of a particle through the geometric model (CL12, L38-48; CL13, L3-17); and

the particle representing an alpha emission emanating from the radiation source during the radiation therapy (CL9, L26-27).

Silver does not expressly teach a method of enlarging a radiation distribution for a treatment volume irradiated during radiation therapy; and computing a distribution of radiation doses based upon the particle movement of the particle. **Moscovitch** teaches a method of enlarging a radiation distribution for a treatment volume irradiated during radiation therapy; and computing a distribution of radiation doses based upon the particle movement of the particle (CL3, L59 to CL 4, L4; CL8, L63-67; CL7, L29-39). The motivation for combining the computer readable medium of **Silver** with the computer readable medium of **Moscovitch** is presented in paragraph 21.1 above.

Silver does not expressly teach describing a movement of a particle through the geometric model in integer based increments. **Kaufman et al.** teaches describing a movement of a particle through the geometric model in integer based increments (Fig. 5A and 5B; Fig 9; CL9, L15-22), because that provides a ray tracing method that is computationally faster than prior art methods (CL3, L56-59). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Kaufman et al.** that included traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer based increments. The artisan would have been motivated because that would provide a ray tracing method that would be computationally faster than prior art methods.

Silver does not expressly teach describing a movement having a primary direction of a particle through the geometric model along the primary direction. **Maki et al.** teaches describing a movement having a primary direction of a particle through the geometric model along the primary direction (CL 9, L35-39; CL9, L53-58), because the particle directions can be used to find a plurality of photon paths traced by a plurality of photons in a model (CL 3, L38-40). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Maki et al.** that included describing a movement having a primary direction of a particle through the geometric model along the primary direction. The artisan would have been motivated because the particle directions could be used to find a plurality of photon paths traced by a plurality of photons in a model.

Silver does not expressly teach the particle representing a beta or gamma emission emanating from the radiation source during the radiation therapy. **Coniglione et al.** teaches the particle representing a beta or gamma emission emanating from the radiation source during the radiation therapy (CL1, L47-56), because it is often preferred to use radiation sources which emit low energy radiation (CL1, L55-56). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Silver** with the method of **Coniglione et al.** that included the particle corresponding to a beta or gamma emission emanating from the radiation source during the radiation therapy. The artisan would have been motivated because it would be often preferred to use radiation sources, which emit low energy radiation.

13.2 As per claim 35, **Silver, Kaufman et al., Moscovitch, Coniglione et al.** and **Maki et al.** teach the method of claim 31. **Silver** teaches a computer readable medium having computer executable modules including computer executable instructions, which when executed on a computer perform a process as recited in claim 30, as presented in Paragraph 12.1 above.

14. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Silver** (U.S. Patent 6,078,681) in view of **Kaufman et al.** (U.S. Patent 5,422,733), and further in view of **Moscovitch** (U.S. Patent 5,498,876), **Coniglione et al.** (U.S. Patent 6,589,502), **Lauer et al.** (U.S. Patent 6,008,813), and **Mackie et al.** (U.S. Patent 6,345,114).

14.1 As per claim 32, **Silver, Kaufman et al., Moscovitch, Coniglione et al.** and **Maki et al.** teach the method of claim 31.

Silver does not expressly teach that the geometric model is comprised of a plurality of substantially uniform volume elements. **Kaufman et al.** teaches that the geometric model is comprised of a plurality of substantially uniform volume elements (Fig. 2; Fig 3; CL1, L66 to CL2, L11; CL2, L34-57). The motivation for combining the method of **Silver** with the method of **Kaufman et al.** is presented in paragraph 12.1 above.

Silver does not expressly teach the step of defining a material to be associated with each the uniform volume element. **Lauer et al.** teaches the step of defining a material to be associated with the treatment volume (CL1, L7-9; CL 4, L39-44). The motivation for combining the method of **Silver** with the method of **Lauer et al.** is presented in paragraph 12.1 above.

Silver does not expressly teach at least one of the uniform volume elements corresponding to the radiation source. **Coniglione et al.** teaches at least one of the uniform volume elements corresponding to the radiation source (CL1, L26-27; CL 10, L13-17). The motivation for combining the method of **Silver** with the method of **Coniglione et al.** is presented in paragraph 21.1 above.

Allowable Subject Matter

15. Claims 5-7, 11-12 and 33-34 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 5 would be allowable because none of the closest prior art teaches "terminating the traversing the particle when the material of the another uniform volume element is substantially different from the material of the one uniform volume element", as taught by the applicants. Claims 6 and 7 depend on claim 5 and therefore would be allowable.

Claims 11 and 12 would be allowable because none of the closest prior art teaches "the particle track has at least one secondary direction of movement, further comprising determining a beginning coordinate value for each secondary direction of movement in response to the determining the center value of the starting element along the primary direction of movement" and "the particle track has at least one secondary direction of movement, and further comprising calculating an error term for each secondary direction of movement, the error terms being used to

adjust a coordinate value whenever the error term exceeds a threshold value", as taught by the applicants.

Claim 33 would be allowable because none of the closest prior art teaches "describing the movement of the particle through the geometric model until the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claim 34 depends on claim 33 and therefore would be allowable.

16. Claims 15, 17-28 and 36-43 would be allowable if the claim objections detailed in Paragraph 5 are overcome.

Claim 15 depends on claim 13 and would be allowable if the claim objection detailed in Paragraph 5 is overcome.

Claim 17 would be allowable, if claim objections detailed in Paragraph 5 is overcome, because none of the closest prior art teaches "simulating a particle movement along each particle track of the plurality of particle tracks through the geometric model in integer based increments along the primary direction of movement until a position when the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claims 18-19 depend on claim 17 and therefore would be allowable, if claim objections detailed in Paragraph 5 are overcome.

Claim 20 would be allowable, if claim objections detailed in Paragraph 5 is overcome, because none of the closest prior art teaches "traversing the particle along the particle track in integer based increments until the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claims 21-28 depend on claim 20 and therefore would be allowable, if claim objections detailed in Paragraph 5 are overcome.

Claim 29 would be allowable, if claim objections detailed in Paragraph 5 are overcome because none of the closest prior art teaches "simulating a particle movement along each particle track of the plurality of particle tracks through the geometric model in integer based increments until a position when the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claim 38 depend on claim 36 and therefore would be allowable, if claim objections detailed in Paragraph 5 are overcome.

Claim 43 would be allowable, if claim objections detailed in Paragraph 5 is overcome, because none of the closest prior art teaches "simulating a particle movement along each particle track of the plurality of particle tracks through the geometric model in integer based increments along the primary direction of movement until a position when the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

17. Claims 13, 14, 16, 36-37, 39 and 40-42 are allowed.

Claim 13 is allowed because none of the closest prior art teaches "following a particle along the particle track through the geometric model until the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claims 14 and 16 depend on claim 13 and therefore are allowed.

Claim 36 is allowed because none of the closest prior art teaches "following a particle along the particle track through the geometric model until the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claims 37 and 39 depend on claim 36 and therefore are allowed.

Claim 40 is allowed because none of the closest prior art teaches "simulating a particle movement along each particle track of the plurality of particle tracks through the geometric model in integer based increments along the primary direction of movement until a position when the material of the next element is substantially different from the material of the starting element", as taught by the applicants.

Claims 41-42 depend on claim 40 and therefore are allowed.

Response to Arguments

18. Applicant's arguments filed on October 22, 2004 have been fully considered. As per the applicant's arguments with respect to 103 (a) rejections, the applicant's attention is requested to the corresponding claim rejections. In addition, the following explanation is provided to further explain the examiner's position.

18.1 As per the applicant's argument that "the Office Action states that the Kaufman et al. reference teaches arranging a plurality of substantially uniform volume elements into the geometric model; and traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer base increments; while the Kaufman et al.

reference, may disclose arranging the plurality of substantially uniform volume elements as voxels, Applicants can find no reference to traversing the particle along the particle track; in addition, neither the Silver reference, nor the Kaufman et al. reference disclose traversing from one uniform volume element to another volume element in integer based increments; Applicants can find no disclosure of integer base increments in either of the references; however, the integer based increments are significant to the present invention in that they reduce required computing power as described at page 25, lines 6-17.", the examiner has used a new reference **Kaufman et al.** (U.S. Patent 5,422,733).

Kaufman et al. teaches traversing the particle along the particle track from one uniform volume element to another uniform volume element in integer based increments (Fig. 5A and 5B; Fig 9; CL9, L15-22), because that provides a ray tracing method that is computationally faster than prior art methods (CL3, L56-59).

18.2 As per the applicant's argument that "the Office Action states that the Coniglione et al. reference teaches the step of defining a material to be associated with the treatment volume because the selected material would determine the desired amount of radiation emitted by the material; Applicants respectfully suggest that this is not what claim 3 recites. Claim 3 recites defining a material to be associated with each said uniform volume element; it appears that the Examiner is considering the entire volume of the geometric model and identifying a material (i.e., radioactive composite in the Coniglione et al. reference) used to treat the region associated with the geometric model; whereas claim 3 recites associating a material of the patient at each uniform volume element...a different material (including anatomical material) may be assigned

to each uniform volume element, rather than a radioactive composite assigned to the entire volume of the geometric model as disclosed in the Coniglione et al. reference and suggested by the Examiner", the examiner has used a new reference **Lauer et al.** (U.S. Patent 6,008,813).

Lauer et al. teaches defining a material to be associated with each of the uniform volume elements (CL1, L12-26; CL 4, L20-39), because voxel data can contain digital information representing the physical characteristics of the objects or phenomena being studied (CL 1, L15-16); a surgeon needing to examine the ligaments, tendons and bones of a human knee in preparation for surgery can utilize a tomographic scan of the knee and cause the voxel data values corresponding to blood, skin and muscle to appear on the screen (CL2, L36-41).

18.3 As per the applicant's argument that "Applicants assert that the Tumer reference does not teach or suggest the element of describing a particle track with a primary direction of movement through said geometric model; the Tumer reference appears to discuss directions of gamma rays and recoil electrons, but, these directions appear to be vectors that can point in any direction within a given coordinate system, such as, for example, a Cartesian coordinate system. However, the present invention includes a specific meaning for primary direction which is different from the directions disclosed in the Tumer reference; in particular, the present invention defines a primary direction as a vector parallel with the X, Y, or Z axis of a Cartesian coordinate system represented by the coordinates of the univels; this is evidenced by page 24, lines 2-10 of the specification describing primary, secondary, and tertiary directions of movement", the examiner has used a new reference **Maki et al.** (U.S. Patent 5,678,556).

Maki et al. teaches that the particle track has a primary direction of movement, further comprising traversing the particle along the particle track along the primary direction of movement (CL 9, L35-39; CL9, L53-58), because the particle directions can be used to find a plurality of photon paths traced by a plurality of photons in a model (CL 3, L38-40).

Conclusion

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 571-272-3717. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska, can be reached on 571-272-3716. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-9600.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

K. Thangavelu
Art Unit 2123
December 9, 2004